

# Lunisolar System of Sasak Rowot Calendar Based On the Pleiades Cluster

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**Abstract.** Sasak Rowot Calendar is a traditional calendar in Lombok. It uses three systems at once, lunar for religious events, solar for social activities, and stars for season determination. This research aims to discuss how the Sasak tribe formulates a lunar-based calendar. It used a qualitative method with a cultural study approach, by interviewing Sasak cultural figures and related literature. The findings show that the Rowot Sasak calendar has 29 and 30 days in a month with an 8-year cycle (*widon*), and a "5-15-25" pattern namely *gandang rowot* for seasons determination. The length of the day in each season varies, between 23 and 41 days. Then, the solar calendar system is used for conversion into an international calendar. The Sasak Rowot Calendar was formulated by dividing the functions of celestial bodies used in it. The existence of this calendar makes it easy to prepare all religious and social activities, including season reading and determination.

**Keywords:** *Rowot Sasak Calendar, Pleiades, Lunisolar Calendar.*

## 1. Introduction

The Sasak Rowot calendar is a calendar developed based on the traditional astronomy of the Sasak tribe. This calendar is used as a guide in holding *gawe* (celebrations), *betaletan* (farming), *mangse* (seasons), good days and bad days, *wuku* (the influence of the position of the clusters on events on the earth), and various other daily activities [1]. The Rowot Sasak calendar works by looking at natural phenomena and observing astronomical phenomena. The astronomical phenomenon in question is the observation of changes in the phases of the moon and the appearance of the Pleiades cluster or the Seven Sister star cluster [2] which is known to the Sasak people as the Rowot star [1]. Meanwhile, the calendar system developed in the world consists of three systems, namely a calendar based on the apparent motion of the sun called the Solar Calendar, a calendar that is based on changes in the phases of the Moon called the Lunar Calendar, and a calendar that uses both which is known as the Luni-solar Calendar [3]. The Rowot Sasak calendar system is basically a synchronization between the Rowot calendar system, the Gregorian calendar system, and the Hijri (Islamic) calendar system [4]. So, it can be said that the Rowot Sasak calendar adheres to the lunisolar system because it combines three time calculation systems in one calendar.

Research on the Sasak Rowot calendar so far has only focused on describing the part components of the calendar or the system for determining certain days. Some of these studies include *first*, determining the beginning of the year in the Rowot Sasak calendar using the appearance of the Pleiades cluster [5]. This research only focuses on one system in the Rowot Sasak calendar, which is determining the beginning of the year by using the appearance of the Rowot star (*solar system*). Meanwhile, in this present study, we describe all of the system calendars in Rowot Sasak calendar and analyze the relationship between the systems. Another research was conducted on the season system (*mangse*) by looking at its mathematical patterns [6]. And, this research only focuses on determining the season in the Rowot Sasak calendar which is then formulated in mathematical patterns. So, the main difference with the current research is that we analyze the existence and interrelationship of the three systems in the Rowot Sasak calendar. The third previous research focused on studying the procedure for determining the beginning of the month in the Rowot Sasak calendar [7]. It focused on the determination of the beginning of the Hijri month (*lunar system*) in the Rowot Sasak calendar. So, the difference between these two studies is clear, where we analyze the connection between the three calendar systems that exist in the Rowot Sasak calendar.

Almost all studies focus on descriptions of some parts of the Sasak Rowot calendar such as the beginning of the year, the beginning of the month, or the beginning of the season (*mangse*). Addressing this gap, we offer a complete study of the calendar system of the lunisolar in the Rowot Sasak calendar.

As the Rowot Sasak calendar adopts 3 calendar systems at once, it needs carefulness to read this calendar so that each of its functions can be used optimally in daily life. So far, there is no research on the Rowot Sasak calendar that specifically talks about the synchronization of the system in the Rowot Sasak calendar. Mostly it only discusses parts of the system separately in the calendar. Therefore, specific research is needed on the Rowot Sasak calendar system which is categorized as a lunisolar system.

Due to a lack of research focusing on studying the lunisolar system in the Rowot Sasak calendar, it is pivotal to conduct further research regarding the Rowot Sasak calendar system. This research is to analyse the combination of the calendar system between the Hijri system (lunar calendar) and the appearance of the Pleiades cluster or Rowot star for the *mangse* (season) calculation system and the solar system calendar or Gregorian calendar. So that, it can answer how the Sasak tribe formulated a lunar-based calendar that was linked to the seasonal system using the Pleiades cluster as a reference.

## 2. Method

This research is categorized as qualitative research with the type of field research and uses a cultural studies approach [8]. Cultural studies itself is a social research paradigm that seeks to reveal and reconcile the compartmentalization of knowledge, overcoming the division between invisible knowledge (intuitive knowledge based on local culture) and objective (which is called universal) [9]. It is explained in general the traditional knowledge related to the Rowot Sasak calendar system as a local knowledge that lives in the community (intuitive). Then we analyzed it into a scientific study to make the traditional knowledge into an objective scientific study (universal). Data collection in this research used observation, interview, and documentation techniques [10] to reveal more depth about the Sasak Rowot calendar system. Meanwhile, data analysis techniques went through the stages of data reduction where we collected as much data as possible and then reduced the data as needed. Then, we conducted a data display by compiling

the data that had been reduced into a general to specific framework and then made a conclusion. And finally, we conducted data verification to ensure that the data compiled were still in accordance with the data obtained from the main sources such as the results of field observations or interviews with cultural experts. [11].

### 3. Results and Discussions

#### 3.1 Pleiades Cluster or Rowot Stars

**Pleiades Cluster.** The Pleiades or Kartika Cluster in astronomy is also called the Messier 45 object, which is an open star cluster in the constellation Taurus [12]. The Pleiades is a bright star cluster that can be observed with the naked eye. In fact, the Pleiades is one of the closest clusters to Earth [13]. The cluster is dominated by hot blue stars formed less than 100 million years ago. Astronomers scientifically try to estimate that the Pleiades star cluster will only last for another 250 million years. The Pleiades star cluster will be destroyed or scattered due to gravitational interactions with surrounding objects [14].

Historically, the Pleiades were seen as a group of 'seven stars' consisting of bright stars including Alcyone, Atlas, Electra, Maia, Merope, Taygete, and Pleione [15]. However, modern observations show that the most famous of these open clusters consists of several hundred stars encased in a complex nebula. This cluster may contain as many as 3000 stars in total [13]. The Pleiades star cluster is estimated to be 440 light years from the solar system. This Pleiades cluster was first photographed by Paul and Prosper Henry in 1885 [16].

The Pleiades have been the inspiration for many mythologies and legends around the world. However, what is more interesting is that in reality, the Pleiades cluster looks much more beautiful [17]. In Indonesian culture, the Pleiades cluster has quite a strong mythology. In Javanese astrology tradition, the Pleiades cluster is known as *Lintang Kartika*. Meanwhile, among the Sasak tribe, the Pleiades cluster is known as the Rowot star.

**Rowot Star.** Rowot star is the traditional name given by the Sasak people to one of the bright star clusters, namely the Pleiades cluster [1]. In astronomy, the Pleiades have another name, "Seven Sisters" with the code M45 [18]. In the traditional Sasak community, knowledge about astronomy and its functions has been used for a long time as a reference for traveling, farming, or other life activities by the community. The most widely circulated and developed mythology among the Sasak people is that the Rowot star is the incarnation of the Mandalika princess who disappeared during a thunderstorm on the southern coast of Lombok. Some people believe that apart from being a *nyalé* (sea worm), the Mandalika princess also transformed herself into a Rowot star.

Traditional Sasak society has named many clusters for astrological and navigational purposes. Among the many clusters, there are two groups of clusters that have an important role in determining the seasons, namely the clusters of Rowot (Pleiades) and *Tenggale* (Orion) [19]. Traditional Sasak society has also taught generation to generation how to observe the Rowot star, namely by marking the appearance of the Rowot star in the Northeast at dawn using the calendar pattern.

For traditional Sasak people, the Rowot star (Pleiades) is the main marker to recognize the movement of *mangse* (seasons) from *ketaun* (rainy) to *kebalit* (dry). The appearance and

disappearance of the Rowot star mark the beginning and the end of *mangse* on the Rowot Sasak calendar.

### 3.2 Sasak Rowot Calendar System

#### Hijri System in Sasak Rowot Calendar

The Hijri system in the Rowot calendar is the result of the acculturation of Islamic tradition into Sasak culture. This form of acculturation can be seen in the names of the days and months of the Rowot Sasak Calendar which adapts the Hijri calendar but has undergone cultural interpretation. Thus, the Hijri system becomes the main system in the Rowot calendar calculation pattern. It includes calculations for a commemoration of cultural events and religious events (Islamic Holiday Commemoration) [20]. This Hijri system is the same as the Islamic Hijri calendar system. However, what differentiates it from the current Hijri calendar system is the reckoning system. The Islamic Hijri calendar currently uses contemporary essential reckoning, namely by observing the new moon (*rukyyatul hilal*) [21]. Meanwhile, the Hijri system in the Rowot Sasak calendar uses the *Urfi* (conventional) reckoning method. Lalu Agus Faturrahman even provided information that this Hijri system was taken from classical Malay books entitled *Tajul Muluk* and *Syumulus Anwar* [5]. So literally, the Hijri system pattern in the Rowot Sasak calendar has a fixed number of days every month, i.e., an odd month (such as the first and the third month) is 30 days and an even month (such as the second and the fourth month) is 29 days, except for the 12th month which is 30 days if it is in a long (leap) year [22]. The year series on the Rowot Sasak calendar still uses the year series from the Hijri calendar. This is because the system adopted by the Rowot Sasak Calendar is the Hijri calendar reckoning system. However, the year cycle used is the *Windon* system, namely an 8-year cycle like most Indonesian calendars [23]. Meanwhile, the names of the months in the Rowot Sasak Calendar are adopted from the months in the Hijri calendar, e. g. Rabi'ul Awal as *Mulud*, Rajab as *Mi'raj*, Ramadhan as *puase*, Shawal as *Lebaran Kodeq* and Dzulhijjah as *Lebaran Beleq*. Likewise, the names of days also use *Ahad* for Sunday [1].

#### ***Mangse* (Seasons) System in Sosok Rowot Calendar.**

The *mangse* (seasons) system or determination of seasonal shifts in the Sasak Rowot calendar is very dependent on the annual circulation of the Rowot star (Pleiades). Culturally, this procession of observing seasonal changes using the Pleiades cluster is called *ngandang* Rowot [21]. *Ngandang* Rowot means "facing the Rowot star", which is a condition where traditional *Kiyai* (leader) will observe the position of the Rowot star on the eastern horizon at dawn [21]. If according to the calculations, the date has occurred, then it is considered that the Rowot star has returned to its original position. Currently, *Ngandang* Rowot is also determined regularly using the traditional 5-15-25 pattern which is the reckoning for determining the appearance of the Rowot star in the cultural interpretation of the Sasak people [6]. The uniqueness of this pattern is that this one is very dependent on the Hijri calendar system in the Sasak Rowot calendar, namely determining the date 5-15-25 using the Sasak Rowot Calendar with the *urfi* system. This pattern is a three-year pattern that repeats regularly in determining *mangse* changes. Apart from that, if this pattern is synchronized with the Gregorian calendar, the *ngandang* Rowot procession will consistently fall in May every year [8], see Tabel 1 as an example.

**Table 1.** *Ngandang Rowot* (facing the Rowot star) Pattern

Hijri Year	<i>Ngandang Rowot</i>	
	Hijri	Gregorian
1443	5 Shawal	7 May 2022
1444	15 Shawal	6 May 2023
1445	25 <i>Shawal</i>	5 May 2024

For the Sasak people, the tradition of the appearance of the Rowot star is the main marker to recognize the shift of *mangse* (season) from *ketaun* (rainy) to *kebalit* (dry). *Kebalit* or dry season starts from the beginning of the calendar or *ngandang Rowot*. This *kebalit* starts from May to November. Meanwhile, the *ketaun*, or rainy season starts from December to April [1].

*Mangse* in the Sasak Rowot calendar itself consists of 12 months divided into 6 months of the dry season plus 1 month of the peak of the dry season and 5 months of the rainy season. The 6-month dry season starts from May – October, while the peak of the dry season occurs between October and November. The length of the day in each season varies between 23 days to 41 days.

### 3.3 Concept of Lunisolar System in Sasak Rowot Calendar

The lunisolar concept in the Sasak Rowot calendar can be seen in how the Sasak Rowot calendar system is built. The system pattern built on the Rowot Sasak calendar is quite complex to read. This is because there are three calendar systems contained in one calendar. The three systems are the Rowot calendar system, the Gregorian calendar system, and the Hijri calendar system. At first glance it will seem confusing, how a calendar can accommodate three systems at once. However, if detailed, the main system for the Rowot Sasak calendar is the Hijri calendar [24]. Meanwhile, the Rowot calendar (with reference to the Pleiades cluster) is a calendar used by people to determine the beginning of seasons [25], whether the dry season (*kebalit*) or the rainy season (*ketaun*). On the other hand, the solar calendar system is used as a form of conversion into a general (international) calendar so that it is easy to read by the public. So, it can be said that the Rowot Sasak calendar system is in the lunisolar system category.

The most clearly visible concept of the lunisolar system is in the combination of the Sasak Rowot calendar calculation system combined with the system for determining the change of *mangse* (seasons). These two systems use two different celestial bodies to calculate their respective systems. The Sasak Rowot calendar uses the *urfi* reckoning system on the averages of moon phases as a reference, while determining the *mangse* (season) uses the appearance of the Rowot star (Pleiades). The annual pattern of the Pleiades appearance is usually the same as the annual pattern of the Sun's position in the ecliptic. Apart from that, the combination of the Sasak Rowot calendar calculation with the *mangse* calculation using the Rowot star is clearly visible in the 5-15-25 pattern. The pattern for determining the initial date of the Sasak Rowot calendar is a synchronization between the Sasak Rowot Calendar's calculation and the appearance of the Rowot star. The synchronization referred to is the date 5-15-25 in the pattern for determining *mangse*, based on the calculation of *urfi* lunar date. For example, it begins on 5 Shawal 1443, then the next year it begins on 15 Shawal 1444, and then 25 Shawal 1445. Addition of 10 days [26] each year to align the lunar calendar with the solar calendar. The twelve seasons in one year are similar to the *Pranata Mangsa* calendar in Java with the names of the seasons according to the Sasak language. The length of the day in each season varies between

23 days and 41 days. Meanwhile, the initial determination of the month (*sekeq* month) remains based on the *ngandang* Rowot or the appearance of the Pleiades cluster. So it requires carefulness from readers of the Sasak Rowot calendar to be able to separate the two systems. The readers of Rowot Sasak calendar really have to be observant to read this calendar, because there are three systems in this calendar at once. First, the Rowot Sasak calendar adopts the Hijri calendar system which uses the *urfi* calculation of the moon phases. This Hijri system is used in religious and social activities in the community. So, many cultural rituals and Islamic holidays are determined using this calendar such as Ramadan fasting, Eid al-Fitr, and Eid al-Adha. To read the date on this calendar, it is necessary to pay close attention to the numbers. The numbers on the dates in the Rowot Sasak calendar use Arabic numerals for the Hijri calendar and Roman numerals for Gregorian. Likewise, the year series is also a combination of the Hijri and Gregorian year series. Meanwhile, to read the season (*mangse*), the reader must look at the 5-15-25 pattern in May. This 5-15-25 pattern is a seasonal pattern, so we must be careful in looking at the date 5-15-25. However, the date is not the date of the Gregorian calendar, but the date of the Hijri calendar contained in the month of May. For example, in 2023 the pattern used is the second pattern, which is the date of 15. So, the date to be searched is the 15th date in the Hijri calendar contained in the month of May. The 15th of Hijri coincides with May 6, 2023. So, the beginning of the season (*mangse*) begins on May 6, 2023.

#### **4. Conclusions**

The Sasak people, as the direct owners of the Sasak Rowot calendar, really understand how they calculate time using natural markers such as celestial bodies. So that, the Sasak Rowot calendar can adopt three-time calculation systems at once. First, the calendar calculation is done using the calculation of the *urfi* Hijri calendar. Secondly, the calculation of time is based on the change of seasons (*mangse*) through the *ngandang* Rowot procession or observing the journey and appearance of the Rowot star (Pleiades). Third, the Gregorian calendar is a companion to the general public calendar. However, if detailed, the main system for the Rowot Sasak calendar is the Hijri calendar. Meanwhile, the Rowot calendar (with a reference to the Pleiades cluster) is a calendar used by people to determine the beginning of seasons, whether the dry season (*kebalit*) or the rainy season (*ketaun*). It was also found that the initial pattern of the *mangse* was a 5-15-25 pattern which was repeated regularly for three years. However, these two systems are combined in the Rowot Sasak calendar, because to calculate the duration of the seasons (*mangse*), they still use the number series on the Rowot Sasak calendar. On the other hand, the solar calendar system is used as a form of conversion into a general calendar. It means The Sasak formulated the Sasak Rowot Calendar by dividing the functions of celestial bodies used in it. So that, it is easy to read by the general public. That is why the Sasak Rowot calendar can be categorized as the lunisolar system. The existence of this calendar in the community makes it easy for people to prepare all their religious and social activities, including season readings for agricultural purposes. However, the Rowot Sasak calendar must immediately find its own year series, because so far it still depends on the Hijri and Gregorian year series. This is needed to make it easier to read the calendar as a whole.

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